

SEDIMENT SURVEYS: A MEASURE OF ENVIRONMENTAL POLLUTION

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JMG Survey

Sediments are widely recognised as a suitable medium for assessing environmental quality as they reflect and integrate contaminant inputs to the marine environment allowing sources and sinks to be identified (e.g. ICES, 1989).

The Joint Monitoring Group of the Oslo and Paris Commissions initiated an international programme to assess the spatial distribution of metal and organic contaminants in marine sediments throughout the shelf sea around north-western Europe. Seabed samples for this survey were collected in 1990 and 1991. Figure 1 shows the distribution of samples around England and Wales.

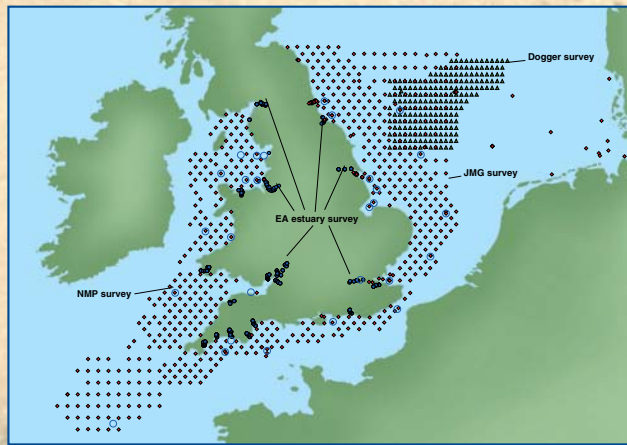


Figure 1. Sampling stations around the UK.

Estuary Survey

In 1992/93, sediment samples were collected from 34 estuaries around England and Wales (Figure 1). Estuaries affected by industrial pollution were sampled, together with those in unpolluted areas.

Figure 2 shows the concentrations of lead compared to the concentration of aluminium in three estuaries with different pollution status.

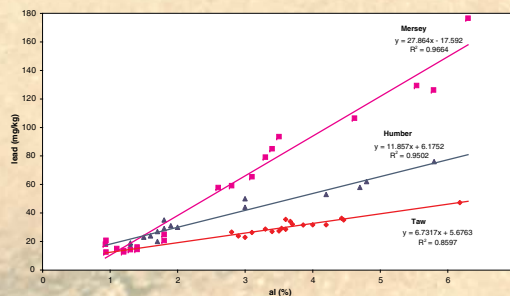


Figure 2. Lead in sediments from three UK estuaries

National Monitoring Programme

The National Monitoring Programme includes the analysis of sediments from estuaries and offshore. Figure 1 shows the distribution of offshore samples around England and Wales.

Nine sediment samples were collected from each station to allow for the calculation of variability. The samples were arranged in a face centred cubic pattern. Normalisation was carried out at all sites.

Normalisation

Detailed analysis of sediment information is only possible after compositional variations have been taken into account. Variations may be caused by mineralogical and grain-size differences. Normalisation takes account of this and allows contaminant concentrations in different samples to be compared with each other.

Normalisation can be achieved using a number of different methods. We favour a regression based method in which the degree to which a sample deviates from the regression is calculated (Figure 3).

Collection and analysis of sediments

Most samples were collected using a Day grab fitted with stainless steel jaws, but where the substrate was either too hard or too gravelly for the effective use of this device, a stainless steel Shipek grab was employed instead.

Approximately 1 kg of the surface (0-1 cm) layer of sediment was taken using a polyethylene scoop and stored in a polyethylene container at -18°C. On return to the laboratory the samples were defrosted, subsampled wet and about 150 g freeze dried, the remainder being returned to an archive freezer. Each freeze-dried sub-sample was sieved at 2 mm to remove gravel particles and any large detritus. The sub-sample was then split further to yield a 30g sub-sample that was ground to a powder using a mechanical agate mortar and pestle.

500 mg of the powder was completely digested in a microwave oven using a mixture of hydrofluoric acid and nitric acid (Jones and Laslett, 1994). The resulting solution was treated to minimise matrix effects before being analysed for a range of elements including cadmium, chromium, copper, iron, lead, manganese, mercury, zinc, aluminium and lithium. Methods used included Inductively Coupled Plasma - Mass Spectrometry and Atomic Absorption Spectroscopy. Sediments were analysed in batches of 12; 9 unknowns, 2 certified reference materials and 1 blank.

Samples of the sediments were also analysed for organic carbon and a range of organic compounds including PCBs and pesticide residues.

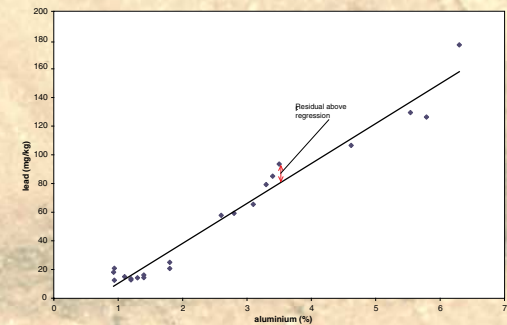


Figure 3. Lead in sediments from the River Mersey showing residual



Collecting a sediment sample with the Day grab.

References

- ICES, 1989. Report of the ICES Advisory Committee on Marine Pollution. (International Council for the Exploration of the Sea Co-op. Res. Rep. 167).
- Jones, B.R. and Laslett, R.E. 1994. Methods for analysis of trace metals in marine and other samples. Aquatic Environment Protection: Analytical methods. MAFF Direct Fish. Res., Lowestoft, (11), 29pp.